MARKS & CLERK

Patent and Trade Mark Attorneys

incorporating Roystons

European Patent Attorneys
Chartered Patent Attorneys
European Trade Mark Attorneys
Registered Trade Mark Attorneys

Manchester Office
Sussex House
83-85 Mosley Street
Manchester M2 3LG

Tel: +44 (0)161 233 5800
Fax: +44 (0)161 236 5846
manchester@marks-clerk.com
www.marks-clerk.com

10/553541

JC20 Rec'd PCT/PTO 17 OCT 2005

International Preliminary Examining Authority
European Patent Office
The Hague
P.O. Box 5818
Patentlaan 2
2280 HV Rijswijk
Netherlands

15 February 2005

<u>BY FACSIMILE TRANSMISSION</u>: 00 31 70 340 3016

Dear Sirs,

Re: **PCT Application No. PCT/GB2004/001511**
Applicant: ROBINSON, JAMES ANDREW
<u>Our Ref: NSP/PAC/P089357WO</u>

In response to the Written Opinion mailed 26th July 2004, we file herewith an amended set of claims to replace those presently on file. Also enclosed is a manuscript-amended copy of the replaced claims to assist the Examiner in identifying the changes which have been made.

It is respectfully requested that the International Preliminary Examining Authority take into account the amendments and arguments explained and advanced in this letter, when considering the present application.

The claims have been amended to indicate that the location from which the gas is withdrawn is adjacent to condensate formed from the condensing gas. Basis for this amendment lies generally within the specification as originally filed e.g. page 2, paragraph 3, page 6, paragraph 2, page 11, paragraphs 1 and 3, and page 12, paragraph 2.

It is submitted that the present invention as defined in amended claims 1 and 2, is novel and possesses an inventive step over documents D1 and D2.

Neither of the cited prior art documents describes an apparatus in which non-condensing gas is withdrawn from at least one location within the condenser, the location being adjacent to condensate formed from the condensing gas.

EPO553706 (D1) refers to a method of cooling and drying compressed air without risk of ice formation – comprises heat exchanger containing cooling channel and drier forming single unit. The described concept relates to the incorporation of a first zone to cool the gas to just above the freezing point and remove condensate, which minimises the problem of icing up in the second zone which then further cools the gas below the freezing point.

EPO856714 (D2) is also a method of reducing icing up in a gas drier. The aim of the described apparatus is to use two heat exchange surfaces being operated alternately, where one is exposed to the coolant and the other is not.

With particular regard to the novelty of the present invention as defined in claim 1 and claim 2, as explained in the specification, the remaining non-condensing gas in a condenser (or other plant) restricts its performance more than is generally recognised. The present invention relates to the removal of unwanted non-condensing gas from a specific location or locations, in order to increase the energy efficiency of the plant item.

For instance, consider the operation of a heat removal device extracting heat from gas in an item of plant. The dominant processes at the gas-liquid interface are (i) the total pressure of the gas mixture is the same as that throughout the volume of the device; (ii) the partial pressure of the condensing gas at the gas/liquid interface is its saturation pressure; (iii) therefore the balance is the partial pressure of the gas/gases that is/are not condensing (Dalton's Law); (iv) most of the temperature difference between bulk gas and the cold surface is between the bulk gas and the gas/liquid interface – that between the interface and the cold surface is less important.

The present invention thus reduces the concentration of the unwanted non-condensing gas(es) adjacent the location of the surface on to which the condensing gas condenses (e.g. the surface of the heat removal device in a condenser) to reduce both the total pressure of the bulk gas and the resistance to heat flow from it, and prevents non-condensing gas accumulating adjacent the surface of a condensate pool (e.g. in a condenser or a steriliser) and so also reduces total pressure.

This reduction in total pressure is advantageous. In a condenser used with a turbine for electricity generation, the steam expands to a lower pressure, thus increasing the electrical output. In a steriliser, the reduction in total pressure is also advantageous, as it reduces the partial pressure of the non-condensing gas, and so reduces the time required to vent this gas.

In other words, the inventor has discovered that the optimal place for removing this unwanted gas is where the bulk gas temperature is relatively low i.e. adjacent condensate. The inventor has thereby improved the efficiency of known condensers and other plant.

Documents D1 and D2 describe plant that does condense steam into water. However there is no mention of the desire to remove an unwanted gas from a condenser; the condensers disclosed being concerned with a problem relating to the solidification of the condensate. Documents D1 and D2 relate to methods of cooling and drying compressed air without the risk of ice formation. There is no suggestion or disclosure of trying to remove an unwanted gas away from adjacent condensate. Furthermore, there is no disclosure or suggestion of having a means for removing the unwanted gas or indeed the location of the opening of such a means. Thus, the cited prior art documents are concerned with an entirely different problem.

Neither documents D1 or D2 provide a gas withdrawal means arranged to withdraw gas at a location adjacent to condensate formed from the condensing gas. Both D1 and D2 do provide gas outputs, but these are not located adjacent to condensate.

By providing gas withdrawal means adjacent to condensate, the present invention leads to an increase in the efficiency of a condenser or other plant.

It is therefore respectfully submitted that the present invention as defined in amended claim 1 and claim 2 is both novel and inventive over the cited prior art.

With regard to novelty and inventive step of the dependent claims, it is noted that the Examiner indicated in the International Search Report that there was no cited document that was of particular relevance to claims 3-33. Furthermore, it is noted that documents D1 and D2 (EP 0553706 and EP 0856714) define the general state of the art and are <u>not</u> considered to be of particular relevance for these claims.

By implication, it is assumed that the Examiner at the time of writing the International Search Report understood that the invention as defined in claims 3-33 was new and involved an inventive step in view of the cited documents.

As well as the independent claims being both novel and inventive, it is submitted that many of the dependent claims are also novel and inventive. For instance, the subject matter of claim 3, claim 6, claim 7, and many other of the dependent claims is believed to be both novel and inventive. Thus, if the Examiner wishes to maintain the position that the subject matter of these claims is obvious, then the Examiner is explicitly requested that he indicate why he considers, in each instance, the subject matter of each claim to be either new or obvious, based upon the teaching of known prior art documents.

We look forward to receiving a favourable Written Opinion from the International Preliminary Examining Authority in due course.

Yours faithfully

Neil Parkinson

NEIL PARKINSON
MARKS & CLERK
Direct Dial No. 0161 233 5829
e-mail: nparkinson@marks-clerk.com

CLAIMS

1. A method for removing non-condensing gas from a mixture of condensing and non-condensing gases in a condenser, wherein gas is withdrawn from at least one location within the condenser, the location being selected to correspond to a region within the condenser in which the gas is at a temperature which is lower than the temperature of gas in other regions within the condenser and adjacent to condensate formed from the condensing gas.

2. A condenser for condensing gas in which gas is condensed to liquid on a heat exchanging surface, comprising means for withdrawing gas from within the condenser to remove non-condensing gas, the gas withdrawing means being positioned to withdraw gas from at least one location in which the gas temperature is lower than in other regions within the condenser and adjacent to condensate formed from the condensing gas.

3. A condenser according to claim 2, wherein the gas withdrawing means comprises cooling means for producing a localised region of relatively cold gas in the location from which gas is withdrawn.

4. A condenser according to claim 3, wherein the cooling means comprise a heat exchanger on which gas condenses.

5. A condenser according to claim 3 or 4, wherein the cooling means comprises means positioned to be cooled by condensing liquid.

6. A condenser according to claim 5, wherein the cooling means comprises at least one deflector located beneath the heat exchanging surface such that droplets of liquid fall onto and cool the deflector, the gas withdrawing means extracting air from beneath the deflector.

7. A condenser according to claim 6, wherein the or each deflector is a cover extending over an upwardly extending gas withdrawal pipe.

8. A condenser according to claim 6, wherein the or each deflector is an elongate gas withdrawal duct a lower side of which defines apertures through which gas is withdrawn into the elongate duct.

9. A condenser according to claim 6, wherein the or each deflector is an elongate duct an underside of which defines an open channel, the gas withdrawing means being connected to one end of the elongate duct.

10. A condenser according to claim 8 or 9, wherein the elongate duct extends beneath and in parallel with a heat exchanger tube of the condenser.

11. A condenser according to claim 6, 7, 8, 9 or 10, wherein a shield is located above the or each deflector to shield falling droplets of condensate from gas flowing through the condenser.

12. A condenser according to claim 3, wherein the cooling means comprises a surface which is cooled by a flow of coolant.

13. A condenser according to claim 12, wherein the surface of the cooling means is cooled by a flow of coolant to a temperature lower than any heat exchange surface within the condenser.

14. A condenser according to claim 12, wherein the cooling means comprises primary and secondary heat exchangers both defining heat exchange surfaces, the heat exchange surface of the primary heat exchanger being located upstream of the heat exchange surface of the secondary heat exchanger in the flow of gas to be condensed, and the secondary heat exchanger being cooled to a lower temperature than the primary heat exchanger.

15. A condenser according to claim 14, wherein the primary and secondary heat exchangers are cooled by flows of coolant derived from separate sources, the coolant

of the secondary heat exchanger being at a lower temperature than the coolant of the first heat exchanger.

16. A condenser according to any one of claims 2 to 15, comprising an auxiliary heat exchanger within the condenser, and means for pumping condensed liquid through the auxiliary heat exchanger, the auxiliary heat exchanger being located such that the condensed liquid within it is heated by the gas to be condensed.

17. A condenser according to claim 16, wherein the auxiliary heat exchanger is located upstream of the said heat exchanging surface in the flow of gas to be condensed.

18. A condenser according to claim 12, wherein the cooled surface is defined by a pool of condensed liquid in thermal contact with a cooling device.

19. A condenser according to claim 12, wherein the cooled surface is defined by a wall of the condenser in thermal contact with a cooling device.

20. A condenser according to claim 19, wherein the condenser wall is defined by a cover plate which covers an aperture in the condenser, gas being withdrawn through the cover plate.

21. A condenser according to claim 20, comprising means for monitoring the pressure and temperature of gas adjacent the cover plate, and means for controlling the cooling means to maintain the temperature of the cover plate above the freezing point of the condensed liquid.

22. A method for establishing favourable temperature differences between heat exchanger conduits within a condenser and a process fluid which flows through the condenser, wherein coolant is pumped through an array of parallel heat exchanger conduits spaced apart in the direction of process fluid flow, at least two of the conduits being connected in series such that coolant flows sequentially through first

and second conduits, the second conduit being located upstream of the first conduit in the direction of process fluid flow.

23. A condenser comprising an array of parallel heat exchanger conduits spaced apart in the direction of flow of a process fluid flow including a gas to be condensed, wherein at least two conduits that are spaced apart in the direction of fluid flow are connected in series such that coolant flows sequentially through first and second conduits, the second conduit being located upstream of the first conduit in the direction of process fluid flow.

24. A condenser according to claim 23, wherein a first pair of first and second conduits are connected in series, a second pair of first and second conduits are connected in series, the direction of flow of coolant through the condenser being in one direction for the first conduit of the first pair and the second conduit of the second pair and in the opposite direction for the second conduit of the first pair and the first conduit of the second pair, the second conduit of the first pair being located upstream in the process flow of the first conduit of the second pair, and the second conduit of the second pair being located upstream in the process flow of the first conduit of the first pair.

25. A condenser according to claim 23 or to claim 24, wherein the parallel heat exchanger conduits comprise parallel heat exchanger tubes.

26. A condenser according to claim 23, wherein the parallel heat exchanger conduits are defined by a staggered array of baffles, each baffle extending transverse the direction of flow of the process fluid, with alternate baffles extending from opposite sides of the condenser, the condenser further comprising an array of process fluid tubes extending through the baffles for said flow of the process fluid.

27. A method for minimising the pressure within a containment vessel resulting from the release into the vessel of a pressurised gas which will condense to a liquid at the temperatures and pressures assumed to prevail within the containment vessel,

wherein a body of the liquid of large surface area relative to the area of the vessel is established in a lower portion of the vessel.

28. A containment vessel intended to contain a release into the vessel of pressurised gas which will condense to a liquid at the temperatures and pressures assumed to prevail within the containment vessel, the containment vessel initially being filled with a gas or gases which will not condense at the temperatures and pressures assumed to prevail within the containment vessel, and the containment vessel including means for establishing in a lower portion of the vessel a body of the liquid of large surface area relative to the area of the vessel.

29. The containment vessel according to claim 28, comprising at least one open tray arranged to collect condensing liquid to form the said body of liquid.

30. A containment vessel according to claim 28, comprising means for releasing a stored volume of the liquid into at least one open tray to form the said body of liquid.

31. A containment vessel according to claim 30, comprising means for sensing pressure within the containment vessel, and means for releasing the stored volume of liquid in the event of the sensed pressure exceeding a predetermined threshold.

32. A condenser substantially as hereinbefore described with reference to any one or more of Figures 8 to 15 and 17.

33. A containment vessel substantially as hereinbefore described with reference to Figure 16.

10/553541

(A) = and adjacent to condensate formed from the condensing gas.

CLAIMS

1. A method for removing non-condensing gas from a mixture of condensing and non-condensing gases in a condenser, wherein gas is withdrawn from at least one location within the condenser, the location being selected to correspond to a region within the condenser in which the gas is at a temperature which is lower than the temperature of gas in other regions within the condenser. ← (A)

2. A condenser for condensing gas in which gas is condensed to liquid on a heat exchanging surface, comprising means for withdrawing gas from within the condenser to remove non-condensing gas, the gas withdrawing means being positioned to withdraw gas from at least one location in which the gas temperature is lower than in other regions within the condenser. ← (A)

3. A condenser according to claim 2, wherein the gas withdrawing means comprises cooling means for producing a localised region of relatively cold gas in the location from which gas is withdrawn.

4. A condenser according to claim 3, wherein the cooling means comprise a heat exchanger on which gas condenses.

5. A condenser according to claim 3 or 4, wherein the cooling means comprises means positioned to be cooled by condensing liquid.

6. A condenser according to claim 5, wherein the cooling means comprises at least one deflector located beneath the heat exchanging surface such that droplets of liquid fall onto and cool the deflector, the gas withdrawing means extracting air from beneath the deflector.

7. A condenser according to claim 6, wherein the or each deflector is a cover extending over an upwardly extending gas withdrawal pipe.